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Forest Pest Management Report

R-3 84-9

BIOLOGICAL EVALUATION
Spruce Beetle
Population Trend and Timber Resource Losses

Fort Apache Indian Reservation
Arizona

February 1984

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USDA Forest Service, Southwestern Region
State and Private Forestry
Forest Pest Management
517 Gold Avenue, SW
Albuquerque, New Mexico 87102

PREPARED AND RECOMMENDED BY:

James P. Linnane

JAMES P. LINNANE, Entomologist
Forest Pest Management

William G. Telfer

WILLIAM G. TELFER, Entomologist
Forest Pest Management

APPROVED BY:

Douglas L. Parker

DOUGLAS L. PARKER
Director of Forest Pest Management

INTRODUCTION

The spruce beetle, Dendroctonus rufipennis (Kirby), continues to cause extensive mortality to Engelmann spruce on portions of the Fort Apache Indian Reservation. This current outbreak was initially detected in the spring of 1981. In both 1981 and 1982, Forest Pest Management (FPM) evaluated this spruce beetle situation (Ragenovich 1982, Linnane 1983). These evaluations describe the situation during their respective years. In 1982, the volume losses to spruce beetle were estimated to fall between 97.0 to 122.7 MMBF, with additional spruce mortality predicted (Linnane 1983).

A special task force assembled by the Bureau of Indian Affairs (BIA) studied this problem early in 1983 (Anonymous 1983). This study estimated future gross revenue losses resulting from the outbreak at $41 million for currently merchantable sawtimber and $16 million in growing stock (less than 11 inches d.b.h.). Considering these values, the BIA requested another evaluation of the spruce beetle situation. With the BIA's cooperation and participation, this survey was undertaken in the fall of 1983.

The intent of this evaluation was (1) to estimate the number and volume of currently attacked trees, (2) predict the infestation trend, and (3) provide management alternatives and recommendations. Survey data were collected by FPM and BIA personnel during September 12-22, 1983.

TECHNICAL INFORMATION

Insect. Spruce beetle, Dendroctonus rufipennis (Kirby)

Host. Engelmann spruce, Picea engelmannii Parry

Life History and Evidence of Infestation. Schmid and Frye (1977) and Massey and Wygant (1954) describe the spruce beetle life cycle and behavior in detail. Briefly, Dendroctonus rufipennis predominantly has a 2-year life cycle, although 1- and 3-year life cycles have been described. Adult D. rufipennis usually attack host trees during May, June, and possibly early July. Egg gallery construction and oviposition continue through the summer. Immature larvae are present by October and overwinter. Larvae resume feeding in spring and develop to pupae before late summer. Pupae transform to adults which overwinter a second time. These insects emerge in the late spring to attack new host material.

Spruce beetles generally prefer to attack green windthrown or other recently downed spruce. As a result, endemic beetle populations are always present, breeding in scattered down material, in the spruce-fir forest type. Outbreaks generally begin after a major forest disturbance (i.e., a large windthrow) creates an abundance of suitable breeding material. Beetle populations rapidly increase in the down material and then readily attack standing spruce. Under favorable conditions, outbreaks may persist until suitable host material is depleted. On occasion, unfavorable climatic conditions, principally extreme cold, cause outbreaks to collapse.

Spruce beetle outbreaks are difficult to detect. Tree crowns fade approximately 1 year after attack; however, discolored needles may remain on twigs for only a short duration, making recently attacked trees difficult to separate from snags. Newly attacked trees can often only be detected by close examination for boring dust. Pitch tubes may or may not be readily visible.

History of Spruce Beetle on the Fort Apache Indian Reservation. Ragenovich (1982) summarized the history of spruce beetle on the Fort Apache Indian Reservation as follows: "Large areas of spruce mortality were first detected in the White Mountains of the Fort Apache Indian Reservation in 1904. This mortality was most likely the result of spruce beetle activity. The first recorded spruce beetle outbreak occurred from 1948 to 1952, when an estimated 22 percent of the spruce was killed in the Ord Creek drainage. The next recorded outbreak occurred from 1968 to 1971 when beetle populations built up in down material and spread to standing green trees, killing tens of thousands of trees in five drainages. The outbreak subsided abruptly in 1971 when record-low temperatures caused high larval mortality."

Location and Extent of the Current Outbreak. This outbreak was initially detected in 1981. Subsequently, attacked trees have been detected throughout the spruce-fir type on reservation lands including the Mount Baldy Wilderness Area (figure 1). There are approximately 38,600 acres of type on the reservation. In 1982, an aerial detection survey estimated 100,000 fading spruce in this zone. The detection survey in 1983 estimated over 200,000 fading spruce, with approximately 75,000 of these trees occurring within the wilderness area. Outside the wilderness, the spruce-fir type has been divided into five management compartments. In 1983, Burnt Mountain and Bull Cienega compartments had high concentrations of fading spruce, while, Diamond Butte, Tiger Butte, and Mount Ord compartments had fewer fading spruce than in the previous year. Spruce beetle activity also increased on adjacent lands within the Apache-Sitgreaves National Forests, principally in the Mount Baldy Wilderness Area.

Host Stand Condition. Infested stands are predominately spruce (approximately 60 percent of basal area); other principal species are corkbark fir, Abies lasiocarpa var arizonica (Merriam) Lemm., aspen, Populus tremuloides Mich., and Douglas-fir, Pseudotsuga menziesii (Mirb.) Franco. Average diameter of live spruce is now approximately 15 inches. Stand basal areas range from 170 to 200 square feet per acre. Standing infested and dead spruce are abundant in many areas, as well as down spruce from past spruce beetle outbreaks.

The 1982 biological evaluation (Linnane 1983) estimated average current attacked spruce at 2.6 trees per acre. Also, estimates on beetle-killed spruce basal area to date ranged between 17.4 and 29.8 percent. Volume losses were placed between 97.0 and 122.7 MMBF.

METHODS

Survey Design. A systematic variable plot cruise following a stratified random sampling design was used to estimate tree losses and beetle activity in the five management compartments. Stratification of currently fading spruce was accomplished utilizing an aerial sketch map. The sketch map provided the locations and intensities of 1982 spruce beetle attacks. From this information, spruce beetle activity was delineated into three strata; low (<1 fader per acre), moderate (>1 <3 faders per acre), and heavy (>3 faders per acre). An estimate of sample size for the tree strata was determined using a method described by Freese (1974). Using proportional allocation, the approximate sample size to achieve an accuracy of ± 0.8 attacked trees per acre at the 0.05 probability level is estimated by:

$$N = \frac{N(\Sigma N_h s_h^2)}{\frac{N^2 E^2}{4} + \Sigma N_h s_h^2}$$

Where: N = area sample
N_h = stratum size
s_{h_2} = within stratum variance
E^h = desired error

Strata variance estimates were derived from the 1982 survey. Table 1 presents compartment and strata sizes, and estimated number of samples.

Cruise lines were located in cardinal directions across contour at 20-chain intervals over the entire spruce-fir forest type in each compartment. Variable point sample plots were located along cruise lines at 5- to 10-chain intervals, depending on required sampling intensity for the various strata. Variable point sampling was accomplished using a 30 BAF prism.

Data Collection. All sample trees were tallied by species and diameter. Spruce was classed in one of five damage categories based on beetle activity: (1) green--uninfested spruce; (2) 1983 attacks--parent adults, eggs, or small larvae present; (3) 1982 attacks--fading foliage and large larvae, pupae, or adults present; (4) old attacks--no spruce beetle present and foliage mostly dropped; (5) partial attack--beetle attacks limited to one side of bole and foliage green.

Data Analysis. Data were compiled and analyzed using the "PEST" program at the Fort Collins Computer Center. This program provides the average trees per acre and basal area per acre estimates by damage categories, with standard deviation and standard error estimates.

For the various strata, estimates of means and standard errors were computed using methods described by Freese (1962). Trees per acre and basal area estimates for the management compartments were computed by expanding strata estimates proportional to stratum size within the compartment.

Volume estimates were computed by the BIA. Board-foot estimates were made for trees 12 inches or greater in diameter. Cubic-foot estimates were made for trees less than 12 inches in diameter.

RESULTS

Sampling Intensity. A systematic variable plot cruise was completed on 20,082 acres of spruce-fir forest type outside of the Mount Baldy Wilderness Area. A total of 694 samples points were measured in the 3 strata. Stratum 1 (low) contained 460 plots; stratum 2 (moderate) contained 95 plots; and stratum 3 (high) contained 139 plots.

Tree Losses. Estimates of spruce beetle-attacked trees along with nonhost tree estimates for the strata are presented in tables 2 and 3. Tree losses (total attacks including partial attacks) ranged from 16.6 trees per acre in the low stratum to 24.7 trees per acre in the moderate stratum (table 2). The mean for all strata was 17.4 trees per acre, with a standard error estimate of 7 percent.

Estimates for numbers of currently attacked spruce for the low, moderate, and high strata were 1.2, 2.2, and 1.6 trees per acre, respectively. The mean for all strata was 1.3 trees per acre, with a standard error estimate of 23 percent.

Basal area estimates for all beetle-attacked spruce (including partial attacks) ranged from 23.3 square feet per acre in the low stratum to 35.4 square feet per acre in the high stratum (table 3). The mean for all strata was 26.0 square feet per acre, with a standard error estimate of 5 percent. Survey data indicated 15.8, 22.4, and 27.4 percent of the spruce basal area for the low, moderate, and high strata, respectively, has been attacked by spruce beetles.

Table 4 presents basal area and trees per acre estimates for green and beetle-attacked spruce for the management compartments by calculating weighted averages of the strata estimates for each compartment. For 1983 beetle-attacked spruce, estimates ranged from a low of 1.2 trees per acre in the Sunrise compartment to a high of 1.4 trees per acre in both the Mount Ord and Bull Cienega compartments.

Gross Volume Losses. Table 5 presents gross volume estimates for green and beetle-infested spruce, corkbark fir, Douglas-fir, aspen, and other tree species for the various compartments. These volume estimates were based on the stratified cruise data. For spruce 12 inches d.b.h. and larger, the gross volume of all categories of infested trees ranged from 3.53 MBF per acre in the Sunrise compartment to 4.49 MBF per acre in the Burnt Mountain compartment. Based on total compartment acreages (20,082 acres), 82.8 MMBF of spruce has been attacked by spruce beetle. This estimate is lower than the 1982 estimate of 97 to 122 MMBF (Linnane 1983) due primarily to a refinement of total spruce-fir acreage estimates excluding nonforested acreage, the salvage of approximately 15 MMBF during the past year, and the fact that the current estimate includes only spruce 12 inches d.b.h. and larger. Sampling error is also a factor.

Stand Structure and Composition. Spruce beetle infested stands within areas surveyed average approximately 196 square feet of basal area per acre. Seventy-three percent of the overstory basal area is spruce. Other major tree species present include corkbark fir (b.a. = 26.5 square feet per acre), Douglas-fir (b.a. = 14.6 square feet per acre), and aspen (b.a. = 11.7 square feet per acre).

Tables 6 through 17 present population stand table data for host and nonhost tree species by the various strata. From this data, there are approximately 73, 63, and 60 standing spruce per acre larger than 12 inches d.b.h. in the low, moderate, and high strata, respectively. Of these trees, approximately 15.4, 21.9, and 25.9 percent (>12 inches d.b.h.) have been attacked by spruce beetle thus far in the outbreak. The residual green spruce above 12 inches d.b.h. is estimated at 62, 49, and 44 trees per acre for the low, moderate, and high strata, respectively. The average diameter of green spruce (>5 inches d.b.h.) in all strata is 15.3 inches.

Infestation Trend. Using the stratified cruise data, the overall ratio of current (1983) to the previous year's (1982) spruce beetle attacks is 1.2, indicating a slight increasing trend, assuming beetle generations are fully overlapping and at approximately equal population levels. However, there is little evidence to support this assumption.

Assumming the majority have a 2-year life cycle, we can compare actual beetle generations. The 1982 survey (Linnane 1983) estimated a mean of 1.7 trees per acre attacked in 1981. If the 1983 attacks are compared to the 1981 estimate (the previous generation), the overall ratio is 0.8, indicating a slight decreasing trend. Examining this trend in depth, the low strata 1983 to 1981 ratio is 1.5; the moderate and high strata 1983 to 1981 ratios are 0.8 and 0.7, respectively.

Comparing actual generations, the data indicate fewer attacks or a decreasing trend in the moderate and high strata and more attacks or an increasing trend in the low stratum. These trends are verified somewhat when examining tables 1 and 4. The Sunrise compartment, which is entirely within the low stratum, showed the greatest increase in frequency of beetle attack (0.8 trees per acre in 1982 and 1.2 trees per acre in 1983), while the Mount Ord compartment, which was heavily attacked in previous years (Linnane 1983), showed the greatest decline (2.1 trees per acre in 1982 to 1.4 trees per acre in 1983).

DISCUSSION

Survey results indicate spruce beetle populations remained at epidemic levels in the spruce-fir type during 1983. However, the frequency of new attacks has declined over previous years. For 1984, the frequency of new attacks is expected to decline from the 1982 levels (2.6 trees per acre), but should remain near the 1983 level, at least above 1 tree per acre. Spruce beetle activity should decrease in areas heavily infested during the past few years (i.e., those areas identified as high or moderate strata during this and the 1982 survey) and may increase slightly in areas identified as low strata in the survey.

As expected, the spruce beetle's greatest impact has been in high basal area stands containing large diameter trees. These type stands are the most susceptible and vulnerable (Schmid and Frye 1976). However, intermediate diameter class trees are currently maintaining the outbreak in many locations. This fact was also reported by Frye and Flake (1972) during a survey of many of the same areas on Fort Apache Indian Reservation.

As stated in prior evaluations (Linnane 1983), the end result of this spruce beetle outbreak will be reductions in total stand basal areas to possibly less than 125 square feet per acre, with the depletion of a high percentage of large diameter spruce. The percent basal area in nonhost trees will increase. This prediction can be verified somewhat by existing data. Between 1968 and 1971, a spruce beetle outbreak occurred in many of the same areas currently infested. During January 1971, an extreme cold period drastically reduced beetle populations (Frye 1971) and the outbreak subsided. However, an extensive cruise was completed in the fall of 1971 (Frye and Flake 1972). Data from this 1971 survey and the 1983 survey are comparable for the Bull Cienega, Diamond Butte, and Mount Ord compartments. Figures 2 through 4 compare stand basal area prior to 1971 and in 1983[1] for these compartments. The general trend over the last 12 years has been a decline in total stand basal area through reduction of the spruce component. While logging may have accounted for some spruce removal, spruce beetle-caused mortality was the principal factor. This trend is expected to continue as long as epidemic levels of spruce beetle exist.

During the survey, it was possible to observe many heavily damaged spruce stands. From these observations, it became evident that most stands contained adequate amounts of spruce reproduction to assure continued spruce dominance of the site. Miller (1970), studying a massive spruce beetle epidemic on the White River Plateau, Colorado, theorized periodic spruce beetle epidemics were an important natural process in maintaining spruce-fir stands in the central Rocky Mountains; these epidemics serving as an ecological trigger for spruce reproduction. The result being the creation of two-storied stands rather than the expected uneven-aged stands. The spruce beetle may be performing this same function on Fort Apache Indian Reservation lands.

ALTERNATIVES

The following alternatives and their components are presented for consideration:

1. No Action. This alternative allows the spruce beetle outbreak to continue, regulated only by natural factors. The outbreak will eventually subside as a result these natural factors which include host depletion, predation, and climate. No direct action is

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[1] These stand basal area estimates were computed by the BIA, and differ slightly from estimates in table 4.

taken against the insect. However, logging to capture the value of damaged timber should be undertaken as described in the following components. These actions will have little or no effect on the progress of the outbreak.

a. Salvage Logging. This action involves logging of highly vulnerable, infested, and dead trees. Large diameter uninfested trees, along with infested and dead material, are felled and transported to millsites. The intent is to maximize utilization while possibly reducing stand vulnerability.

b. Presalvage Logging. This action is a variant of salvage logging designed to utilize susceptible trees. Presalvage involves cutting merchantable trees in anticipation of losses that are likely to occur before definitive regeneration cuts are made to replace the stands (Smith 1962). Under this alternative, stands would be entered and susceptible spruce, principally large diameter, would be removed prior to attack by the spruce beetle. The principal advantage of presalvage over salvage is the market value of the material removed. Green, unifested spruce should have a higher dollar value than dead, infested spruce subjected to spiral checking and other degrades. Clearcutting or partial cutting harvesting methods may be appropriate.

2. Direct Suppression. Under this alternative, direct action is taken to suppress the outbreak. There are several suppression tactics which are described as the following components:

a. Treatment of Individual Infested Trees. This action involves treating infested trees by (1) applying an insecticide, (2) felling and burning, or (3) felling and debarking. The objective, in all cases, is to destroy the developing insect brood. To be effective, a high percentage (>90 percent) of infested trees must be located and treated. In large infestations, this is difficult to impossible.

b. Trap Trees. Under this alternative, uninfested merchantable trees are felled prior to beetle flight. These trees are more attractive to beetles than standing trees and, hence, lure beetles away from standing timber. To be effective, trap trees must be felled in accessible areas to simplify removal. They must be removed or treated prior to the next beetle flight. While the trap-tree approach may be effective on infestations of limited size, it is doubtful any benefit could be derived when used against extensive infestations.

A variation of trap trees is lethal trap trees. Prior to felling, these trees are injected with silvicides. Brood development in these trees is unsuccessful. Lethal trap trees do not necessarily have to be removed.

3. Preventive Insecticidal Spray. The insecticide carbaryl when applied to the bole of bark beetle host trees prevents successful attack by these insects. The preventive spray strategy involves

selecting individual high-value trees, such as along ski trails or around developed recreation sites, and applying carbaryl prior to beetle flight. This strategy has been successfully used against the mountain pine beetle and certain Ips beetles in ponderosa and lodgepole pines. However, little information is available on its effectiveness against the spruce beetle.

RECOMMENDATIONS

No action is the recommended alternative for the current outbreak. As described under this alternative, salvage logging and presalvage logging should be continued as a means of reducing dollar losses to the outbreak. Again, these logging operations will have little overall effect on spruce beetle populations.

In designing salvage or presalvage operations, residual stand windfirmness is an important consideration. Also, any logging operations should be closely monitored to insure a minimum of logging debris remains. Stump height should be kept below 1.5 feet. Cull logs and tops should be bucked into short lengths and scattered laying on the ground in open areas. Log decks containing infested material should be removed to millsites prior to beetle flight.

LITERATURE CITED

Anonymous. 1983. Special spruce beetle study. Bureau of Indian Affairs, Fort Apache Agency, Whiteriver, AZ.

Freese, F. 1962. Elementary forest sampling. USDA Forest Serv., Southern Forest Exper. Sta. Handb. 232. 91 pp.

_____. 1974. Elementary statistical methods for foresters. USDA Forest Serv., Forest Products Laboratory. Handb. 317. 87 pp.

Frye, R. H. 1971. Biological evaluation, spruce beetle winter mortality, Fort Apache Indian Reservation, Arizona. USDA Forest Serv., Southwestern Region. 17 pp.

_____ and H. W. Flake Jr. 1972. Mt. Baldy spruce beetle biological evaluation, population trend, stand structure, and tree resource losses, Fort Apache Indian Reservation, Arizona. USDA Forest Serv., Southwestern Region. 38 pp.

Linnane, J. P. 1983. Biological evaluation, spruce beetle, Fort Apache Indian Reservation, Arizona. USDA Forest Serv., Southwestern Region. R-3 83-6. 32 pp.

Massey, C. L. and N. D. Wygant. 1954. Biology and control of the Englemann spruce beetle in Colorado. USDA Circular No. 944. 35 pp.

Miller, P. C. 1970. Age distributions of spruce and fir in beetle-killed forests on the White River Plateau, Colorado. Am. Midland Nat. 83(1):206-212.

Ragenovich, I. 1982. Biological evaluation, spruce beetle, Fort Apache Indian Reservation, Arizona. USDA Forest Serv., Southwestern Region. R-3 82-6. 22 pp.

Schmid, J. M. and R. H. Frye. 1976. Stand ratings for spruce beetle. USDA Forest Serv., Rocky Mtn. Forest and Range Exper. Stn. Res. Note RM-309. 4 pp.

_____. 1977. Spruce beetle in the Rockies. USDA Forest Service, Rocky Mtn Forest and Range Exp. Sta. Gen Tech. Rep. RM-49. 38 pp.

Smith, D. M. 1962. The practice of silviculture. John Wiley and Sons, Inc. NY 578 pp.

TABLE 1.--Compartment and strata size, and estimated number of samples required for the 1983 spruce beetle survey, Fort Apache Indian Reservation

Compartment	Strata						Totals	
	Low		Moderate		Heavy			
	Acreage	Samples[1]	Acreage	Samples[1]	Acreage	Samples[1]	Acreage	Samples[1]
Diamond Butte	2,604	73	306	10	573	15	3,483	98
Mount Ord	4,362	123	695	22	1,339	35	6,396	180
Bull Cienega	3,112	87	594	19	304	8	4,010	114
Sunrise	2,819	79	0	0	0	0	2,819	79
Burnt Mountain	2,225	63	34	1	1,115	30	3,374	94
Totals	15,122	425	1,629	52	3,331	88	20,082	565

[1] Samples required to achieve an accuracy of ± 0.8 attacked trees per acre at the 0.05-probability level.

TABLE 2.--Trees per acre by species and damage class for the sampling strata, Fort Apache Indian Reservation

Strata	Engelmann Spruce																								
	Green		Attacked 1982		Attacked 1983		Partial attacks		Old attacks		Total attacks			Total spruce	True fir		Douglas-fir		Aspen		Total nonhost		Total all species		% spruce
	T.A.	(S.E.)	T.A.	(S.E.)	T.A.	(S.E.)	T.A.	(S.E.)	T.A.	(S.E.)	T.A.	(S.E.)	%	T.A.	T.A.	(S.E.)	T.A.	(S.E.)	T.A.	(S.E.)	T.A.	(S.E.)	T.A.	(S.E.)	
Low	158.8	(7.3)	0.8	(0.2)	1.2	(0.3)	3.4	(0.3)	13.2	(1.6)	16.6	(1.7)	9.5	175.4	61.8	(5.5)	9.5	(1.6)	20.8	(3.6)	92.2	(6.7)	267.7	(9.8)	65.5
Moderate	143.5	(13.0)	3.7	(1.3)	2.2	(0.9)	2.6	(1.3)	16.2	(3.4)	24.7	(4.4)	14.7	168.2	39.9	(11.5)	4.9	(1.9)	32.2	(12.0)	77.5	(16.3)	245.7	(23.0)	68.5
High	114.9	(11.2)	1.2	(0.4)	1.6	(0.8)	1.6	(0.5)	13.1	(2.0)	17.5	(2.3)	13.2	132.4	29.1	(5.4)	8.6	(2.2)	8.2	(4.0)	46.4	(6.9)	178.9	(14.0)	74.0
Mean	150.3	(5.8)	1.1	(0.2)	3.0	(0.2)	1.3	(0.3)	13.4	(1.2)	17.4	(1.3)	10.4	167.7	54.6	(4.3)	9.0	(1.2)	19.6	(2.9)	83.4	(5.2)	251.2	(7.8)	66.8

TABLE 3.--Basal area by tree species and damage class for the sampling strata, Fort Apache Indian Reservation

Strata	Engelmann Spruce																							
	Green		Attacked				Partial attacks		Old attacks		Total attacks			Total spruce	True fir		Douglas-fir		Aspen		Total nonhost		Total all species	% spruce
			1982		1983																			
	B.A.	(S.E.)	B.A.	(S.E.)	B.A.	(S.E.)	B.A.	(S.E.)	B.A.	(S.E.)	B.A.	(S.E.)	%	B.A.	B.A.	(S.E.)	B.A.	(S.E.)	B.A.	(S.E.)	B.A.	(S.E.)		
Low	124.0	(4.1)	1.6	(0.3)	1.6	(0.5)	2.5	(0.5)	17.6	(1.5)	23.3	(1.9)	15.8	147.3	29.3	(2.1)	15.8	(1.7)	12.3	(1.7)	57.7	(3.4)	204.7	72.0
Moderate	111.8	(8.4)	6.0	(2.2)	2.5	(0.9)	3.8	(1.3)	19.9	(4.0)	32.2	(5.6)	22.4	144.0	22.1	(4.9)	9.8	(3.2)	18.3	(5.6)	50.8	(8.4)	194.2	74.2
High	91.9	(6.7)	2.4	(0.8)	2.8	(1.1)	3.4	(0.9)	26.8	(3.6)	35.4	(4.1)	27.8	127.3	16.4	(2.5)	11.4	(2.4)	5.6	(2.2)	33.4	(4.3)	160.7	79.2
Mean	177.7	(9.8)	2.1	(0.3)	1.9	(0.4)	2.7	(0.4)	19.3	(1.3)	26.0	(1.6)	18.0	143.715	26.5	(2.7)	14.6	(1.9)	11.7	(2.0)	53.1	(7.2)	196.5	73.1

TABLE 4.--Basal area per acre and trees per acre for spruce by damage class in the various management compartments[1]

Damage class	Diamond Butte		Mount Ord		Bull Cienega		Sunrise		Burnt Mountain	
	B.A.	T.A.	B.A.	T.A.	B.A.	T.A.	B.A.	T.A.	B.A.	T.A.
Spruce										
Green	104.0	150.2	115.9	147.9	119.8	153.2	124.0	158.8	113.3	144.1
Attacked 1982	2.1	1.1	2.2	2.1	2.3	1.3	1.6	0.8	1.9	1.0
Attacked 1983	1.9	1.3	1.9	1.4	1.8	1.4	1.6	1.2	2.0	1.3
Partial attack	2.8	3.0	2.8	4.4	2.8	3.1	2.5	3.4	2.8	2.8
Old attacks	19.3	13.4	19.8	14.4	18.6	13.6	17.6	13.2	20.7	13.2
Total attacks	20.2	17.5	26.8	17.7	25.5	17.9	23.3	16.6	27.4	17.0
Total spruce	143.7	167.7	142.7	165.6	145.3	171.1	147.3	175.4	140.7	161.1

[1] Estimates based on strata means

TABLE 5.--Gross volumes per acre by compartment based on spruce beetle stratification

Category	Management compartment									
	Diamond Butte		Mount Ord		Bull Cienega		Sunrise		Burnt Mountain	
	MCF[3]	MBF[4]	MCF	MBF	MCF	MBF	MCF	MBF	MCF	MBF
Spruce										
Green	0.57	12.76	0.57	12.60	0.59	12.93	0.59	13.35	0.54	12.38
Infested	0.04	4.13	0.04	4.29	0.05	3.97	0.04	3.53	0.03	4.49
Total	0.61	16.89	0.61	16.89	0.64	16.90	0.63	16.88	0.57	16.88
True fir	0.23	1.73	0.22	1.70	0.24	1.74	0.26	1.86	0.22	1.69
Douglas-fir	0.01	1.96	0.01	1.90	0.03	1.96	0.01	2.16	0.80	1.92
Other	0	0.34	0	0.32	0	0.37	0	0.44	--	0.03
Aspen[1]	0.15	0.19	0.15	0.19	0.16	0.20	0.17	0.22	0.13	0.19
All species[2]	1.01	20.82	0.99	20.74	1.06	20.86	1.08	21.16	0.93	20.71

[1] Aspen estimates are all cubic foot volumes.
[2] Calulated value is slightly different than the total of all categories due to rounding of decimals.
[3] Thousand cubic feet per acre.
[4] Thousand board feet per acre.

TABLE 6.--FOREST INSECT AND DISEASE

SURVEY SUMMARY

POPULATION STAND TABLE
1983 SURVEY LOW STRATA 1
HOST SPECIES IS ENGELMANN SPRUCE THE PEST IS SPRUCE BEETLE

THE METHOD OF SAMPLING WAS VARIABLE THE FIGURES IN THIS TABLE ARE BASED ON A SAMPLE OF 460 PLOTS, AND REPRESENT AN AREA OF 15122.ACRES.

BAF WAS 30.

THIS TABLE ONLY INCLUDES HOST TREES

NUMBERS OF TREES PER ACRE

DBH	GREEN	CURRENT	PREV 82	PARTIAL	OLD	BLOWDOWN	TTL AK	PERCENT	TOTAL	PERCENTILE
5.0- 5.9	15.305	.000	.000	.000	.000	.000	.000	.000	15.305	8.723
6.0- 6.9	13.950	.000	.000	.000	.996	.000	.996	6.667	14.947	8.519
7.0- 7.9	18.546	.000	.000	.000	.488	.000	.488	2.564	19.034	10.849
8.0- 8.9	13.078	.187	.000	.000	.561	.000	.747	5.405	13.826	7.880
9.0- 9.9	13.286	.000	.000	.000	.886	.000	.886	6.250	14.172	8.077
10.0- 10.9	11.718	.000	.000	.000	1.554	.000	1.554	11.712	13.273	7.565
11.0- 11.9	11.068	.000	.000	.099	.593	.000	.692	5.882	11.760	6.702
12.0- 12.9	9.964	.249	.000	.000	.581	.000	.830	7.692	10.795	6.153
13.0- 13.9	9.410	.071	.071	.142	.495	.000	.778	7.639	10.189	5.807
14.0- 14.9	8.358	.122	.122	.000	1.281	.000	1.525	15.432	9.883	5.633
15.0- 15.9	6.165	.000	.000	.106	.638	.000	.744	10.769	6.909	3.938
16.0- 16.9	6.399	.093	.093	.047	.561	.000	.794	11.039	7.193	4.100
17.0- 17.9	4.469	.124	.207	.290	.703	.000	1.324	22.857	5.793	3.301
18.0- 18.9	4.023	.074	.000	.148	.701	.000	.923	18.657	4.945	2.819
19.0- 19.9	3.246	.000	.099	.066	.629	.000	.795	19.672	4.041	2.303
20.0- 20.9	2.362	.090	.060	.120	.508	.000	.777	24.762	3.139	1.789
21.0- 21.9	2.332	.027	.027	.054	.488	.000	.597	20.370	2.928	1.669
22.0- 22.9	1.680	.025	.074	.124	.346	.000	.568	25.275	2.248	1.281
23.0- 23.9	.955	.000	.045	.045	.249	.000	.339	25.424	1.334	.760
24.0- 24.9	.664	.021	.000	.021	.228	.000	.270	28.889	.934	.532
25.0- 25.9	.555	.000	.019	.019	.153	.000	.191	25.641	.746	.425
26.0- 26.9	.548	.018	.018	.035	.159	.000	.230	29.545	.778	.444
27.0- 27.9	.197	.016	.000	.033	.049	.000	.098	33.333	.295	.168
28.0- 28.9	.122	.000	.000	.000	.076	.000	.076	38.462	.198	.113
29.0- 29.9	.100	.000	.014	.000	.100	.000	.114	53.333	.213	.122
30.0- 30.9	.080	.013	.000	.000	.040	.000	.053	40.000	.133	.076
31.0- 31.9	.050	.000	.000	.012	.075	.000	.087	63.636	.137	.078
32.0- 32.9	.058	.012	.000	.000	.023	.000	.035	37.500	.093	.053
33.0- 33.9	.033	.000	.000	.000	.022	.000	.022	40.000	.055	.031
TOTAL	158.85	1.15	.85	1.36	13.25	.00	16.61	9.46	175.45	100.00
PERCENT	90.54	.66	.48	.78	7.55	.00	9.46			

TABLE 7.--FOREST INSECT AND DISEASE

SURVEY SUMMARY

POPULATION STAND TABLE
1983 SURVEY LOW STRATA 1
HOST SPECIES IS ENGELMANN SPRUCE THE PEST IS SPRUCE BEETLE

THE METHOD OF SAMPLING WAS VARIABLE THE FIGURES IN THIS TABLE ARE BASED ON A SAMPLE OF 460 PLOTS, AND REPRESENT AN AREA OF 15122.ACRES.

BAF WAS 30.

THIS TABLE ONLY INCLUDES HOST TREES

SQ. FT. OF BASAL AREA PER ACRE

DBH	GREEN	CURRENT	PREV 82	PARTIAL	OLD	BLOWDOWN	TTL AK	PERCENT	TOTAL	PERCENTILE
5.0- 5.9	2.087	.000	.000	.000	.000	.000	.000	.000	2.087	1.417
6.0- 6.9	2.739	.000	.000	.000	.196	.000	.196	6.667	2.935	1.992
7.0- 7.9	4.957	.000	.000	.000	.130	.000	.130	2.564	5.087	3.453
8.0- 8.9	4.565	.065	.000	.000	.196	.000	.261	5.405	4.826	3.276
9.0- 9.9	5.870	.000	.000	.000	.391	.000	.391	6.250	6.261	4.250
10.0- 10.9	6.391	.000	.000	.000	.848	.000	.848	11.712	7.239	4.914
11.0- 11.9	7.304	.000	.000	.065	.391	.000	.457	5.882	7.761	5.268
12.0- 12.9	7.826	.196	.000	.000	.457	.000	.652	7.692	8.478	5.755
13.0- 13.9	8.674	.065	.065	.130	.457	.000	.717	7.639	9.391	6.375
14.0- 14.9	8.935	.130	.130	.000	1.370	.000	1.630	15.432	10.565	7.171
15.0- 15.9	7.565	.000	.000	.130	.783	.000	.913	10.769	8.478	5.755
16.0- 16.9	8.935	.130	.130	.065	.783	.000	1.109	11.039	10.043	6.817
17.0- 17.9	7.043	.196	.326	.457	1.109	.000	2.087	22.857	9.130	6.197
18.0- 18.9	7.109	.130	.000	.261	1.239	.000	1.630	18.657	8.739	5.932
19.0- 19.9	6.391	.000	.196	.130	1.239	.000	1.565	19.672	7.957	5.401
20.0- 20.9	5.152	.196	.130	.261	1.109	.000	1.696	24.762	6.848	4.648
21.0- 21.9	5.609	.065	.065	.130	1.174	.000	1.435	20.370	7.043	4.781
22.0- 22.9	4.435	.065	.196	.326	.913	.000	1.500	25.275	5.935	4.028
23.0- 23.9	2.870	.000	.130	.130	.717	.000	.978	25.424	3.848	2.612
24.0- 24.9	2.087	.065	.000	.065	.717	.000	.848	28.889	2.935	1.992
25.0- 25.9	1.891	.000	.065	.065	.522	.000	.652	25.641	2.543	1.726
26.0- 26.9	2.022	.065	.065	.130	.587	.000	.848	29.545	2.870	1.948
27.0- 27.9	.783	.065	.000	.130	.196	.000	.391	33.333	1.174	.797
28.0- 28.9	.522	.000	.000	.000	.326	.000	.326	38.462	.848	.575
29.0- 29.9	.457	.000	.065	.000	.457	.000	.522	53.333	.978	.664
30.0- 30.9	.391	.065	.000	.000	.196	.000	.261	40.000	.652	.443
31.0- 31.9	.261	.000	.000	.065	.391	.000	.457	63.636	.717	.487
32.0- 32.9	.326	.065	.000	.000	.130	.000	.196	37.500	.522	.354
33.0- 33.9	.196	.000	.000	.000	.130	.000	.130	40.000	.326	.221
34.0- 34.9	.196	.000	.000	.000	.065	.000	.065	25.000	.261	.177
35.0- 35.9	.196	.065	.000	.000	.065	.000	.130	40.000	.326	.221
36.0- 36.9	.130	.000	.000	.000	.130	.000	.130	50.000	.261	.177
39.0- 39.9	.065	.000	.000	.000	.065	.000	.065	50.000	.130	.089
40.0- 40.9	.000	.000	.000	.000	.130	.000	.130	100.000	.130	.089
TOTAL	123.98	1.63	1.57	2.54	17.61	.00	23.35	15.85	147.33	100.00
PERCENT	84.15	1.11	1.06	1.73	11.95	.00	15.85			

TABLE 8.--FOREST INSECT AND DISEASE

SURVEY SUMMARY

POPULATION STAND TABLE
1963 SURVEY LOW STRATA 1
HOST SPECIES IS ENGELMANN SPRUCE

THE PEST IS SPRUCE BEETLE

THE METHOD OF SAMPLING WAS VARIABLE. THE FIGURES IN THIS TABLE ARE BASED ON A SAMPLE OF 460 PLOTS, AND

REPRESENT AN AREA OF 15100. ACRES.

BAF WAS 30.

THIS TABLE ONLY INCLUDES NON-HOST TREES

NUMBERS OF TREES

PER ACRE

DBH	CORKBARK	DOUG FIR	ASPEN PI	WHITE PI	OTHER	TOTAL	PERCENTILE
5.0- 5.9	11.001	1.435	1.435	.000	.000	13.871	15.041
6.0- 6.9	8.968	.000	3.321	.000	.000	12.290	13.327
7.0- 7.9	9.517	.244	1.220	.000	.000	10.981	11.908
8.0- 8.9	7.100	.561	2.429	.000	.000	10.089	10.940
9.0- 9.9	5.757	.590	2.952	.000	.000	9.300	10.085
10.0- 10.9	5.620	.359	2.870	.000	.000	8.848	9.595
11.0- 11.9	3.063	.296	1.640	.000	.000	5.040	5.465
12.0- 12.9	2.408	.498	1.329	.000	.083	4.318	4.682
13.0- 13.9	1.769	.495	.778	.000	.000	3.042	3.299
14.0- 14.9	1.769	.366	.549	.000	.000	2.684	2.911
15.0- 15.9	1.329	.266	.213	.000	.053	1.860	2.017
16.0- 16.9	.981	.327	.561	.000	.000	1.869	2.026
17.0- 17.9	.952	.290	.548	.000	.000	1.779	1.929
18.0- 18.9	.480	.480	.185	.000	.000	1.144	1.241
19.0- 19.9	.298	.364	.331	.000	.000	.994	1.078
20.0- 20.9	.299	.329	.179	.000	.000	.807	.875
21.0- 21.9	.081	.325	.027	.000	.000	.434	.470
22.0- 22.9	.148	.321	.074	.000	.000	.544	.589
23.0- 23.9	.158	.249	.045	.000	.000	.452	.490
24.0- 24.9	.000	.311	.021	.000	.000	.332	.360
25.0- 25.9	.019	.210	.019	.000	.000	.249	.270
26.0- 26.9	.018	.318	.000	.000	.000	.336	.364
27.0- 27.9	.018	.213	.000	.000	.000	.230	.249
28.0- 28.9	.000	.076	.000	.000	.015	.092	.099
29.0- 29.9	.000	.071	.000	.000	.000	.071	.077
30.0- 30.9	.000	.120	.000	.013	.000	.133	.144
31.0- 31.9	.012	.025	.000	.000	.000	.037	.040
32.0- 32.9	.012	.093	.000	.000	.000	.105	.114
33.0- 33.9	.000	.033	.022	.000	.000	.055	.060
34.0- 34.9	.000	.052	.000	.000	.000	.052	.056
35.0- 35.9	.000	.039	.000	.000	.000	.039	.042
36.0- 36.9	.000	.046	.000	.000	.000	.046	.050
37.0- 37.9	.000	.035	.000	.000	.000	.035	.038
38.0- 38.9	.000	.008	.000	.000	.000	.008	.009
40.0- 40.9	.000	.007	.000	.000	.000	.007	.008
42.0- 42.9	.000	.007	.000	.000	.000	.007	.007
43.0- 43.9	.000	.006	.000	.000	.000	.006	.007
44.0- 44.9	.000	.012	.000	.000	.000	.012	.013
45.0- 45.9	.000	.006	.000	.000	.000	.006	.006
48.0- 48.9	.000	.005	.000	.000	.000	.005	.006
49.0- 49.9	.000	.005	.000	.000	.000	.005	.005
50.0-100.0	.000	.004	.000	.000	.000	.004	.004
TOTAL	61.78	9.50	20.78	.01	.15	92.22	33.01
PERCENT	66.99	10.30	22.53	.01	.16	100.00	

TABLE 9.--FOREST INSECT AND DISEASE

SURVEY SUMMARY

POPULATION STAND TABLE
1983 SURVEY LOW STRATA 1
HOST SPECIES IS ENGELM SPRUCE

THE PEST IS SPRUCE BEETLE

THE METHOD OF SAMPLING WAS VARIABLE. THE FIGURES IN THIS TABLE ARE BASED ON A SAMPLE OF 460 PLOTS, AND REPRESENT AN AREA OF 17122. ACRES.

BAF WAS 30.

THIS TABLE ONLY INCLUDES NON-HOST TREES

SQ. FT. OF BASAL AREA

PER ACRE

DBH	CORKBARK	DOUG FIR	ASPEN FI	WHITE FI	OTHER	TOTAL	PERCENTILE
5.0- 5.9	1.500	.196	.196	.000	.000	1.891	3.281
6.0- 6.9	1.761	.000	.652	.000	.000	2.413	4.186
7.0- 7.9	2.543	.065	.326	.000	.000	2.935	5.091
8.0- 8.9	2.478	.196	.848	.000	.000	3.522	6.109
9.0- 9.9	2.543	.261	1.304	.000	.000	4.109	7.127
10.0- 10.9	3.065	.196	1.565	.000	.000	4.826	8.371
11.0- 11.9	2.022	.196	1.109	.000	.000	3.326	5.769
12.0- 12.9	1.891	.391	1.043	.000	.065	3.391	5.882
13.0- 13.9	1.630	.457	.717	.000	.000	2.804	4.864
14.0- 14.9	1.891	.391	.587	.000	.000	2.870	4.977
15.0- 15.9	1.630	.326	.261	.000	.065	2.283	3.959
16.0- 16.9	1.370	.457	.783	.000	.000	2.609	4.525
17.0- 17.9	1.500	.457	.848	.000	.000	2.804	4.864
18.0- 18.9	.848	.848	.326	.000	.000	2.022	3.507
19.0- 19.9	.587	.717	.652	.000	.000	1.957	3.394
20.0- 20.9	.652	.717	.391	.000	.000	1.761	3.054
21.0- 21.9	.196	.783	.065	.000	.000	1.043	1.810
22.0- 22.9	.391	.848	.196	.000	.000	1.435	2.489
23.0- 23.9	.457	.717	.130	.000	.000	1.304	2.262
24.0- 24.9	.000	.978	.065	.000	.000	1.043	1.810
25.0- 25.9	.065	.717	.065	.000	.000	.848	1.471
26.0- 26.9	.065	1.174	.000	.000	.000	1.239	2.149
27.0- 27.9	.065	.848	.000	.000	.000	.913	1.584
28.0- 28.9	.000	.326	.000	.000	.065	.391	.679
29.0- 29.9	.000	.326	.000	.000	.000	.326	.566
30.0- 30.9	.000	.587	.000	.065	.000	.652	1.131
31.0- 31.9	.065	.130	.000	.000	.000	.196	.339
32.0- 32.9	.065	.522	.000	.000	.000	.587	1.018
33.0- 33.9	.000	.196	.130	.000	.000	.326	.566
34.0- 34.9	.000	.326	.000	.000	.000	.326	.566
35.0- 35.9	.000	.261	.000	.000	.000	.261	.452
36.0- 36.9	.000	.326	.000	.000	.000	.326	.566
37.0- 37.9	.000	.261	.000	.000	.000	.261	.452
38.0- 38.9	.000	.065	.000	.000	.000	.065	.113
40.0- 40.9	.000	.065	.000	.000	.000	.065	.113
42.0- 42.9	.000	.065	.000	.000	.000	.065	.113
43.0- 43.9	.000	.065	.000	.000	.000	.065	.113
44.0- 44.9	.000	.130	.000	.000	.000	.130	.226
45.0- 45.9	.000	.065	.000	.000	.000	.065	.113
48.0- 48.9	.000	.065	.000	.000	.000	.065	.113
49.0- 49.9	.000	.065	.000	.000	.000	.065	.113
50.0-100.9	.000	.065	.000	.000	.000	.065	.113
TOTAL	29.28	15.85	12.26	.07	.20	57.65	.00
PERCENT	50.79	27.49	21.27	.11	.34	100.00	

TABLE 10.-- FOREST INSECT AND DISEASE

SURVEY SUMMARY

POPULATION STAND TABLE
1983 SURVEY MOD STRATA 2
HOST SPECIES IS ENGLMANN SPRUCE THE PEST IS SPRUCE BEETLE

THE METHOD OF SAMPLING WAS VARIABLE THE FIGURES IN THIS TABLE ARE BASED ON A SAMPLE OF 95 PLOTS, AND REPRESENT AN AREA OF 1629. ACRES.

BAF WAS 30.

THIS TABLE ONLY INCLUDES HOST TREES

NUMBERS OF TREES PER ACRE

DBH	GREEN	CURRENT	PREV 82	PARTIAL	OLD	BLOWDOWN	TTL AK	PERCENT	TOTAL	PERCENTILE
5.0- 5.9	6.948	.000	.000	.000	.000	.000	.000	.000	6.948	4.130
6.0- 6.9	11.258	.000	.000	.000	.000	.000	.000	.000	11.258	6.691
7.0- 7.9	18.906	.000	.000	.000	1.182	.000	1.182	5.882	20.087	11.939
8.0- 8.9	12.665	.000	.000	.905	2.714	.000	3.619	22.222	16.284	9.679
9.0- 9.9	12.866	.000	.715	.000	.715	.000	1.430	10.000	14.296	8.497
10.0- 10.9	17.370	.579	.000	.000	1.737	.000	2.316	11.765	19.686	11.700
11.0- 11.9	14.355	.479	.000	.000	1.914	.000	2.393	14.286	16.748	9.954
12.0- 12.9	6.835	.000	.402	.000	.804	.000	1.206	15.000	8.042	4.780
13.0- 13.9	7.880	.343	.000	.000	.685	.000	1.028	11.538	8.908	5.294
14.0- 14.9	5.908	.295	.295	.000	.886	.000	1.477	20.000	7.385	4.389
15.0- 15.9	6.948	.000	.000	.515	.257	.000	.772	10.000	7.720	4.588
16.0- 16.9	3.619	.000	.226	.226	.226	.000	.679	15.789	4.297	2.554
17.0- 17.9	3.807	.000	.000	.401	.601	.000	1.002	20.833	4.808	2.858
18.0- 18.9	2.859	.000	.357	.000	1.251	.000	1.608	36.000	4.468	2.655
19.0- 19.9	2.566	.160	.481	.160	.000	.000	.802	23.810	3.368	2.002
20.0- 20.9	2.026	.145	.145	.000	.579	.000	.868	30.000	2.895	1.721
21.0- 21.9	1.050	.000	.656	.000	.788	.000	1.444	57.895	2.495	1.483
22.0- 22.9	1.196	.000	.000	.000	.359	.000	.359	23.077	1.555	.924
23.0- 23.9	1.313	.000	.109	.000	.109	.000	.219	14.286	1.532	.911
24.0- 24.9	.804	.101	.101	.101	.201	.000	.503	38.462	1.307	.777
25.0- 25.9	.741	.000	.093	.185	.185	.000	.463	38.462	1.204	.716
26.0- 26.9	.428	.086	.086	.000	.428	.000	.600	58.333	1.028	.611
27.0- 27.9	.477	.000	.000	.000	.159	.000	.159	25.000	.635	.378
28.0- 28.9	.295	.000	.000	.000	.000	.000	.000	.000	.295	.176
29.0- 29.9	.207	.000	.000	.138	.138	.000	.275	57.143	.482	.286
30.0- 30.9	.000	.000	.000	.000	.064	.000	.064	100.000	.064	.038
31.0- 31.9	.120	.000	.000	.000	.181	.000	.181	60.000	.301	.179
33.0- 33.9	.053	.000	.000	.000	.053	.000	.053	50.000	.106	.063
36.0- 36.9	.045	.000	.000	.000	.000	.000	.000	.000	.045	.027
TOTAL	143.55	2.19	3.67	2.63	16.22	.00	24.70	14.68	168.25	100.00
PERCENT	85.32	1.30	2.18	1.56	9.64	.00	14.68			

TABLE 9.--FOREST INSECT AND DISEASE

TABLE 11.--FOREST INSECT AND DISEASE

SURVEY SUMMARY

POPULATION STAND TABLE
1983 SURVEY MOD STRATA 2
HOST SPECIES IS ENGLMANN SPRUCE

THE PEST IS SPRUCE BEETLE

THE METHOD OF SAMPLING WAS VARIABLE THE FIGURES IN THIS TABLE ARE BASED ON A SAMPLE OF 95 PLOTS. AND REPRESENT AN AREA OF 1629. ACRES.

BAF WAS 30.

THIS TABLE ONLY INCLUDES HOST TREES

SQ. FT. OF BASAL AREA

PER ACRE

DBH	GREEN	CURRENT	PREV 82	PARTIAL	OLD	BLOWDOWN	TTL AK	PERCENT	TOTAL	PERCENTILE
5.0- 5.9	.947	.000	.000	.000	.000	.000	.000	.000	.947	.658
6.0- 6.9	2.211	.000	.000	.000	.000	.000	.000	.000	2.211	1.535
7.0- 7.9	5.053	.000	.000	.000	.316	.000	.316	5.882	5.368	3.728
8.0- 8.9	4.421	.000	.000	.316	.947	.000	1.263	22.222	5.684	3.947
9.0- 9.9	5.684	.000	.316	.000	.316	.000	.632	10.000	6.316	4.386
10.0- 10.9	9.474	.316	.000	.000	.947	.000	1.263	11.765	10.737	7.456
11.0- 11.9	9.474	.316	.000	.000	1.263	.000	1.579	14.286	11.053	7.675
12.0- 12.9	5.368	.000	.316	.000	.632	.000	.947	15.000	6.316	4.386
13.0- 13.9	7.263	.316	.000	.000	.632	.000	.947	11.538	8.211	5.702
14.0- 14.9	6.316	.316	.316	.000	.947	.000	1.579	20.000	7.895	5.482
15.0- 15.9	8.526	.000	.000	.632	.316	.000	.947	10.000	9.474	6.579
16.0- 16.9	5.053	.000	.316	.316	.316	.000	.947	15.789	6.000	4.167
17.0- 17.9	6.000	.000	.000	.632	.947	.000	1.579	20.833	7.579	5.263
18.0- 18.9	5.053	.000	.632	.000	2.211	.000	2.842	36.000	7.895	5.482
19.0- 19.9	5.053	.316	.947	.316	.000	.000	1.579	23.810	6.632	4.605
20.0- 20.9	4.421	.316	.316	.000	1.263	.000	1.895	30.000	6.316	4.386
21.0- 21.9	2.526	.000	1.579	.000	1.895	.000	3.474	57.895	6.000	4.167
22.0- 22.9	3.158	.000	.000	.000	.947	.000	.947	23.077	4.105	2.851
23.0- 23.9	3.789	.000	.316	.000	.316	.000	.632	14.286	4.421	3.070
24.0- 24.9	2.526	.316	.316	.316	.632	.000	1.579	38.462	4.105	2.851
25.0- 25.9	2.526	.000	.316	.632	.632	.000	1.579	38.462	4.105	2.851
26.0- 26.9	1.579	.316	.316	.000	1.579	.000	2.211	58.333	3.789	2.632
27.0- 27.9	1.895	.000	.000	.000	.632	.000	.632	25.000	2.526	1.754
28.0- 28.9	1.263	.000	.000	.000	.000	.000	.000	.000	1.263	.877
29.0- 29.9	.947	.000	.000	.632	.632	.000	1.263	57.143	2.211	1.535
30.0- 30.9	.000	.000	.000	.000	.316	.000	.316	100.000	.316	.219
31.0- 31.9	.632	.000	.000	.000	.947	.000	.947	60.000	1.579	1.096
33.0- 33.9	.316	.000	.000	.000	.316	.000	.316	50.000	.632	.439
36.0- 36.9	.316	.000	.000	.000	.000	.000	.000	.000	.316	.219
TOTAL	111.79	2.53	6.00	3.79	19.89	.00	32.21	22.37	144.00	100.00
PERCENT	77.63	1.75	4.17	2.63	13.82	.00	22.37			

TABLE 12.--FOREST INSECT AND DISEASE

SURVEY SUMMARY

POPULATION STAND TABLE
1983 SURVEY MOD STRATA 2
HOST SPECIES IS ENGLMANN SPRUCE THE PEST IS SPRUCE BEETLE

THE METHOD OF SAMPLING WAS VARIABLE THE FIGURES IN THIS TABLE ARE BASED ON A SAMPLE OF 95 PLOTS, AND REPRESENT AN AREA OF 1629. ACRES.

BAF WAS 30.

THIS TABLE ONLY INCLUDES NON-HOST TREES

NUMBERS OF TREES PER ACRE

DBH	CORKBARK	DOUG-FIR	ASPEN-PI	WHITE-FI	OTHER	TOTAL	PERCENTILE
6.0- 6.9	1.608	.000	1.608	.000	.000	3.217	4.153
7.0- 7.9	7.090	.000	3.545	.000	.000	10.634	13.730
8.0- 8.9	13.570	.000	7.237	.000	.000	20.807	26.864
9.0- 9.9	5.004	.000	3.574	.000	.000	8.578	11.075
10.0- 10.9	2.895	.000	5.790	.000	.000	8.685	11.213
11.0- 11.9	2.871	.479	3.828	.000	.000	7.178	9.267
12.0- 12.9	1.608	.000	2.412	.000	.000	4.021	5.191
13.0- 13.9	1.370	.343	1.713	.000	.000	3.426	4.423
14.0- 14.9	.591	.295	.591	.295	.000	1.772	2.288
15.0- 15.9	.257	.000	.257	.000	.000	.515	.664
16.0- 16.9	.905	.679	.905	.000	.000	2.488	3.212
17.0- 17.9	.601	.601	.200	.000	.000	1.402	1.811
18.0- 18.9	.179	.715	.179	.000	.000	1.072	1.384
19.0- 19.9	.321	.481	.160	.000	.000	.962	1.242
20.0- 20.9	.145	.145	.145	.000	.000	.434	.561
21.0- 21.9	.131	.131	.000	.000	.000	.263	.339
22.0- 22.9	.359	.120	.000	.120	.000	.598	.772
23.0- 23.9	.219	.328	.000	.000	.000	.547	.707
24.0- 24.9	.000	.101	.101	.000	.000	.201	.260
27.0- 27.9	.000	.159	.000	.000	.000	.159	.205
28.0- 28.9	.074	.000	.000	.000	.000	.074	.095
29.0- 29.9	.069	.138	.000	.000	.000	.207	.267
31.0- 31.9	.000	.060	.000	.000	.000	.060	.078
32.0- 32.9	.000	.057	.000	.000	.000	.057	.073
34.0- 34.9	.000	.050	.000	.000	.000	.050	.065
35.0- 35.9	.000	.047	.000	.000	.000	.047	.061
TOTAL	39.87	4.93	32.25	.42	.00	77.45	48.53
PERCENT	51.47	6.36	41.63	.54	.00	100.00	

TABLE 13.-- FOREST INSECT AND DISEASE

SURVEY SUMMARY

POPULATION STAND TABLE
1983 SURVEY MOD STRATA 2
HOST SPECIES IS ENGLMANN SPRUCE — THE PEST IS SPRUCE BEETLE

THE METHOD OF SAMPLING WAS VARIABLE — THE FIGURES IN THIS TABLE ARE BASED ON A SAMPLE OF 95 PLOTS, AND REPRESENT AN AREA OF 1629. ACRES.

BAF WAS 30.

THIS TABLE ONLY INCLUDES NON-HOST TREES

SQ. FT. OF BASAL AREA

PER ACRE

DBH	CORKBARK	DOUG-FIR	ASPEN-PI	WHITE-FI	OTHER	TOTAL	PERCENTILE
6.0- 6.9	.316	.000	.316	.000	.000	.632	1.242
7.0- 7.9	1.895	.000	.947	.000	.000	2.842	5.590
8.0- 8.9	4.737	.000	2.526	.000	.000	7.263	14.286
9.0- 9.9	2.211	.000	1.579	.000	.000	3.789	7.453
10.0- 10.9	1.579	.000	3.158	.000	.000	4.737	9.317
11.0- 11.9	1.895	.316	2.526	.000	.000	4.737	9.317
12.0- 12.9	1.263	.000	1.895	.000	.000	3.158	6.211
13.0- 13.9	1.263	.316	1.579	.000	.000	3.158	6.211
14.0- 14.9	.632	.316	.632	.316	.000	1.895	3.727
15.0- 15.9	.316	.000	.316	.000	.000	.632	1.242
16.0- 16.9	1.263	.947	1.263	.000	.000	3.474	6.832
17.0- 17.9	.947	.947	.316	.000	.000	2.211	4.348
18.0- 18.9	.316	1.263	.316	.000	.000	1.895	3.727
19.0- 19.9	.632	.947	.316	.000	.000	1.895	3.727
20.0- 20.9	.316	.316	.316	.000	.000	.947	1.863
21.0- 21.9	.316	.316	.000	.000	.000	.632	1.242
22.0- 22.9	.947	.316	.000	.316	.000	1.579	3.106
23.0- 23.9	.632	.947	.000	.000	.000	1.579	3.106
24.0- 24.9	.000	.316	.316	.000	.000	.632	1.242
27.0- 27.9	.000	.632	.000	.000	.000	.632	1.242
28.0- 28.9	.316	.000	.000	.000	.000	.316	.621
29.0- 29.9	.316	.632	.000	.000	.000	.947	1.863
31.0- 31.9	.000	.316	.000	.000	.000	.316	.621
32.0- 32.9	.000	.316	.000	.000	.000	.316	.621
34.0- 34.9	.000	.316	.000	.000	.000	.316	.621
35.0- 35.9	.000	.316	.000	.000	.000	.316	.621
TOTAL	22.11	9.79	18.32	.63	.00	50.84	.00
PERCENT	43.48	19.25	36.02	1.24	.00	100.00	

TABLE 14.--FOREST INSECT AND DISEASE

SURVEY SUMMARY

POPULATION STAND TABLE
1983 SURVEY HIGH STRATA3
HOST SPECIES IS ENGELMANN SPRUCE THE PEST IS SPRUCE BEETLE

THE METHOD OF SAMPLING WAS VARIABLE THE FIGURES IN THIS TABLE ARE BASED ON A SAMPLE OF 139 PLOTS, AND REPRESENT AN AREA OF 3331.ACRES.

BAF WAS 30.

THIS TABLE ONLY INCLUDES HOST TREES

NUMBERS OF TREES

PER ACRE

DBH	GREEN	CURRENT	PREV 82	PARTIAL	OLD	BLOWDOWN	TTL AK	PERCENT	TOTAL	PERCENTILE
5.0- 5.9	6.331	.000	.000	.000	.000	.000	.000	.000	6.331	4.780
6.0- 6.9	12.091	.000	.000	.000	.000	.000	.000	.000	12.091	9.128
7.0- 7.9	14.536	.000	.000	.000	.000	.000	.000	.000	14.536	10.973
8.0- 8.9	12.366	.000	.000	.000	.000	.000	.000	.000	12.366	9.335
9.0- 9.9	8.305	.000	.000	.000	.977	.000	.977	10.526	9.282	7.007
10.0- 10.9	8.310	.000	.000	.000	.791	.000	.791	8.696	9.101	6.871
11.0- 11.9	8.830	.000	.000	.327	.000	.000	.327	3.571	9.157	6.913
12.0- 12.9	7.694	.000	.000	.000	1.099	.000	1.099	12.500	8.794	6.638
13.0- 13.9	5.620	.468	.000	.000	.702	.000	1.171	17.241	6.790	5.126
14.0- 14.9	5.653	.404	.202	.000	1.211	.000	1.817	24.324	7.470	5.639
15.0- 15.9	4.573	.000	.000	.176	.703	.000	.879	16.129	5.452	4.116
16.0- 16.9	3.401	.000	.000	.155	.155	.000	.309	8.333	3.710	2.801
17.0- 17.9	3.834	.137	.411	.000	.137	.000	.685	15.152	4.519	3.411
18.0- 18.9	3.786	.000	.122	.244	.489	.000	.855	18.421	4.641	3.504
19.0- 19.9	2.302	.219	.110	.110	.767	.000	1.206	34.375	3.508	2.648
20.0- 20.9	1.781	.099	.000	.099	1.187	.000	1.385	43.750	3.166	2.390
21.0- 21.9	1.256	.090	.000	.090	.718	.000	.897	41.667	2.154	1.626
22.0- 22.9	1.145	.082	.082	.164	.654	.000	.981	46.154	2.126	1.605
23.0- 23.9	.898	.000	.150	.000	.449	.000	.598	40.000	1.496	1.129
24.0- 24.9	.412	.000	.000	.000	.344	.000	.344	45.455	.756	.570
25.0- 25.9	.380	.000	.000	.127	.696	.000	.823	68.421	1.203	.908
26.0- 26.9	.468	.000	.039	.000	.527	.000	.585	55.556	1.054	.795
27.0- 27.9	.271	.054	.000	.000	.543	.000	.597	68.750	.869	.656
28.0- 28.9	.202	.000	.000	.000	.303	.000	.303	60.000	.505	.381
29.0- 29.9	.141	.000	.000	.047	.235	.000	.282	66.667	.423	.320
30.0- 30.9	.176	.044	.044	.044	.088	.000	.220	55.556	.396	.299
31.0- 31.9	.041	.000	.000	.041	.041	.000	.082	66.667	.124	.093
32.0- 32.9	.000	.000	.000	.000	.116	.000	.116	100.000	.116	.088
34.0- 34.9	.000	.000	.000	.000	.068	.000	.068	100.000	.068	.052
35.0- 35.9	.000	.032	.000	.000	.032	.000	.065	100.000	.065	.049
36.0- 36.9	.061	.000	.000	.000	.031	.000	.031	33.333	.092	.069
37.0- 37.9	.029	.000	.000	.029	.000	.000	.029	50.000	.058	.044
38.0- 38.9	.027	.000	.000	.000	.000	.000	.000	.000	.027	.021
40.0- 40.9	.025	.000	.000	.000	.000	.000	.000	.000	.025	.019
TOTAL	114.95	1.63	1.18	1.65	13.06	.00	17.52	13.23	132.47	100.00
PERCENT	86.77	1.23	.89	1.25	9.86	.00	13.23			

TABLE 15.--FOREST INSECT AND DISEASE

SURVEY SUMMARY

POPULATION STAND TABLE
1983 SURVEY HIGH STRATA3
HOST SPECIES IS ENGELMANN SPRUCE — THE PEST IS SPRUCE BEETLE

THE METHOD OF SAMPLING WAS VARIABLE — THE FIGURES IN THIS TABLE ARE BASED ON A SAMPLE OF 139 PLOTS, AND

REPRESENT AN AREA OF 3331. ACRES.

BAF WAS 30.

THIS TABLE ONLY INCLUDES HOST TREES

SQ. FT. OF BASAL AREA

PER ACRE

DBH	GREEN	CURRENT	PREV 82	PARTIAL	OLD	BLOWDOWN	TTL AK	PERCENT	TOTAL	PERCENTILE
5.0- 5.9	.863	.000	.000	.000	.000	.000	.000	.000	.863	.678
6.0- 6.9	2.374	.000	.000	.000	.000	.000	.000	.000	2.374	1.864
7.0- 7.9	3.885	.000	.000	.000	.000	.000	.000	.000	3.885	3.051
8.0- 8.9	4.317	.000	.000	.000	.000	.000	.000	.000	4.317	3.390
9.0- 9.9	3.669	.000	.000	.000	.432	.000	.432	10.526	4.101	3.220
10.0- 10.9	4.532	.000	.000	.000	.432	.000	.432	8.696	4.964	3.898
11.0- 11.9	5.827	.000	.000	.216	.000	.000	.216	3.571	6.043	4.746
12.0- 12.9	6.043	.000	.000	.000	.863	.000	.863	12.500	6.906	5.424
13.0- 13.9	5.180	.432	.000	.000	.647	.000	1.079	17.241	6.259	4.915
14.0- 14.9	6.043	.432	.216	.000	1.295	.000	1.942	24.324	7.986	6.271
15.0- 15.9	5.612	.000	.000	.216	.863	.000	1.079	16.129	6.691	5.254
16.0- 16.9	4.748	.000	.000	.216	.216	.000	.432	8.333	5.180	4.068
17.0- 17.9	6.043	.216	.647	.000	.216	.000	1.079	15.152	7.122	5.593
18.0- 18.9	6.691	.000	.216	.432	.863	.000	1.511	18.421	8.201	6.441
19.0- 19.9	4.532	.432	.216	.216	1.511	.000	2.374	34.375	6.906	5.424
20.0- 20.9	3.885	.216	.000	.216	2.590	.000	3.022	43.750	6.906	5.424
21.0- 21.9	3.022	.216	.000	.216	1.727	.000	2.158	41.667	5.180	4.068
22.0- 22.9	3.022	.216	.216	.432	1.727	.000	2.590	46.154	5.612	4.407
23.0- 23.9	2.590	.000	.432	.000	1.295	.000	1.727	40.000	4.317	3.390
24.0- 24.9	1.295	.000	.000	.000	1.079	.000	1.079	45.455	2.374	1.864
25.0- 25.9	1.295	.000	.000	.432	2.374	.000	2.806	68.421	4.101	3.220
26.0- 26.9	1.727	.000	.216	.000	1.942	.000	2.158	55.556	3.885	3.051
27.0- 27.9	1.079	.216	.000	.000	2.158	.000	2.374	68.750	3.453	2.712
28.0- 28.9	.863	.000	.000	.000	1.295	.000	1.295	60.000	2.158	1.695
29.0- 29.9	.647	.000	.000	.216	1.079	.000	1.295	66.667	1.942	1.525
30.0- 30.9	.863	.216	.216	.216	.432	.000	1.079	55.556	1.942	1.525
31.0- 31.9	.216	.000	.000	.216	.216	.000	.432	66.667	.647	.508
32.0- 32.9	.000	.000	.000	.000	.647	.000	.647	100.000	.647	.508
34.0- 34.9	.000	.000	.000	.000	.432	.000	.432	100.000	.432	.339
35.0- 35.9	.000	.216	.000	.000	.216	.000	.432	100.000	.432	.339
36.0- 36.9	.432	.000	.000	.000	.216	.000	.216	33.333	.647	.508
37.0- 37.9	.216	.000	.000	.216	.000	.000	.216	50.000	.432	.339
38.0- 38.9	.216	.000	.000	.000	.000	.000	.000	.000	.216	.169
40.0- 40.9	.216	.000	.000	.000	.000	.000	.000	.000	.216	.169
TOTAL	91.94	2.81	2.37	3.45	26.76	.00	35.40	27.80	127.34	100.00
PERCENT	72.20	2.20	1.86	2.71	21.02	.00	27.80			

TABLE 16.--FOREST INSECT AND DISEASE

SURVEY SUMMARY

POPULATION STAND TABLE
1983 SURVEY HIGH STRATA3
HOST SPECIES IS ENGELMANN SPRUCE — THE PEST IS SPRUCE BEETLE

THE METHOD OF SAMPLING WAS VARIABLE — THE FIGURES IN THIS TABLE ARE BASED ON A SAMPLE OF 139 PLOTS, AND REPRESENT AN AREA OF 3331. ACRES.

BAF WAS 30.

THIS TABLE ONLY INCLUDES NON-HOST TREES

NUMBERS OF TREES PER ACRE

DBH	CORKBARK	DOUG-FIR	ASPEN-PI	WHITE-FI	OTHER	TOTAL	PERCENTILE
5.0- 5.9	4.749	.000	1.583	.000	.000	6.331	13.636
6.0- 6.9	3.298	1.099	.000	.000	.000	4.397	9.470
7.0- 7.9	4.038	.808	.000	.000	.000	4.845	10.436
8.0- 8.9	3.710	1.237	.618	.000	.000	5.565	11.985
9.0- 9.9	.977	.000	1.954	.000	.000	2.931	6.313
10.0- 10.9	1.979	.396	.000	.396	.000	2.770	5.966
11.0- 11.9	2.616	.654	.654	.000	.000	3.924	8.452
12.0- 12.9	1.924	.275	1.374	.000	.000	3.572	7.694
13.0- 13.9	1.405	.468	.000	.000	.000	1.873	4.034
14.0- 14.9	1.413	.202	.606	.000	.000	2.221	4.783
15.0- 15.9	.528	.352	.528	.000	.000	1.407	3.030
16.0- 16.9	.773	.464	.309	.000	.000	1.546	3.329
17.0- 17.9	.685	.274	.274	.000	.000	1.232	2.654
18.0- 18.9	.244	.122	.244	.000	.000	.611	1.315
19.0- 19.9	.219	.329	.000	.000	.000	.548	1.180
20.0- 20.9	.297	.396	.099	.000	.000	.791	1.705
21.0- 21.9	.090	.269	.000	.000	.000	.359	.773
22.0- 22.9	.000	.245	.000	.000	.000	.245	.528
23.0- 23.9	.075	.299	.000	.000	.000	.374	.806
24.0- 24.9	.069	.000	.000	.000	.000	.069	.148
25.0- 25.9	.000	.127	.000	.000	.000	.127	.273
26.0- 26.9	.059	.117	.000	.000	.000	.176	.378
27.0- 27.9	.000	.054	.000	.000	.000	.054	.117
29.0- 29.9	.000	.141	.000	.000	.000	.141	.304
30.0- 30.9	.000	.088	.000	.000	.000	.088	.189
31.0- 31.9	.000	.082	.000	.000	.000	.082	.177
33.0- 33.9	.000	.073	.000	.000	.000	.073	.157
35.0- 35.9	.000	.032	.000	.000	.000	.032	.070
39.0- 39.9	.000	.026	.000	.000	.000	.026	.056
45.0- 45.9	.000	.020	.000	.000	.000	.020	.042
TOTAL	29.14	8.65	8.24	.40	.00	46.43	37.23
PERCENT	62.77	18.63	17.75	.85	.00	100.00	

TABLE 17.-- FOREST INSECT AND DISEASE

SURVEY SUMMARY

POPULATION STAND TABLE
1983 SURVEY HIGH STRATA3
HOST SPECIES IS ENGELMANN SPRUCE — THE PEST IS SPRUCE BEETLE

THE METHOD OF SAMPLING WAS VARIABLE. THE FIGURES IN THIS TABLE ARE BASED ON A SAMPLE OF 139 PLOTS, AND REPRESENT AN AREA OF 3331. ACRES.

BAF WAS 30.

THIS TABLE ONLY INCLUDES NON-HOST TREES

SQ. FT. OF BASAL AREA

PER ACRE

DBH	CORKBARK	DOUG-FIR	ASPEN-PI	WHITE-FI	OTHER	TOTAL	PERCENTILE
5.0- 5.9	.647	.000	.216	.000	.000	.863	2.564
6.0- 6.9	.647	.216	.000	.000	.000	.863	2.564
7.0- 7.9	1.079	.216	.000	.000	.000	1.295	3.846
8.0- 8.9	1.295	.432	.216	.000	.000	1.942	5.769
9.0- 9.9	.432	.000	.863	.000	.000	1.295	3.846
10.0- 10.9	1.079	.216	.000	.216	.000	1.511	4.487
11.0- 11.9	1.727	.432	.432	.000	.000	2.590	7.692
12.0- 12.9	1.511	.216	1.079	.000	.000	2.806	8.333
13.0- 13.9	1.295	.432	.000	.000	.000	1.727	5.128
14.0- 14.9	1.511	.216	.647	.000	.000	2.374	7.051
15.0- 15.9	.647	.432	.647	.000	.000	1.727	5.128
16.0- 16.9	1.079	.647	.432	.000	.000	2.158	6.410
17.0- 17.9	1.079	.432	.432	.000	.000	1.942	5.769
18.0- 18.9	.432	.216	.432	.000	.000	1.079	3.205
19.0- 19.9	.432	.647	.000	.000	.000	1.079	3.205
20.0- 20.9	.647	.863	.216	.000	.000	1.727	5.128
21.0- 21.9	.216	.647	.000	.000	.000	.863	2.564
22.0- 22.9	.000	.647	.000	.000	.000	.647	1.923
23.0- 23.9	.216	.863	.000	.000	.000	1.079	3.205
24.0- 24.9	.216	.000	.000	.000	.000	.216	.641
25.0- 25.9	.000	.432	.000	.000	.000	.432	1.282
26.0- 26.9	.216	.432	.000	.000	.000	.647	1.923
27.0- 27.9	.000	.216	.000	.000	.000	.216	.641
29.0- 29.9	.000	.647	.000	.000	.000	.647	1.923
30.0- 30.9	.000	.432	.000	.000	.000	.432	1.282
31.0- 31.9	.000	.432	.000	.000	.000	.432	1.282
33.0- 33.9	.000	.432	.000	.000	.000	.432	1.282
35.0- 35.9	.000	.216	.000	.000	.000	.216	.641
39.0- 39.9	.000	.216	.000	.000	.000	.216	.641
45.0- 45.9	.000	.216	.000	.000	.000	.216	.641
TOTAL	16.40	11.44	5.61	.22	.00	33.67	.00
PERCENT	48.72	33.97	16.67	.64	.00	100.00	

FIGURE 1.--Location of survey area, Fort Apache Indian Reservation

FIGURE 2.--Histogram of basal area by all tree species, live spruce, and non-spruce species for the Bull Cienega compartment

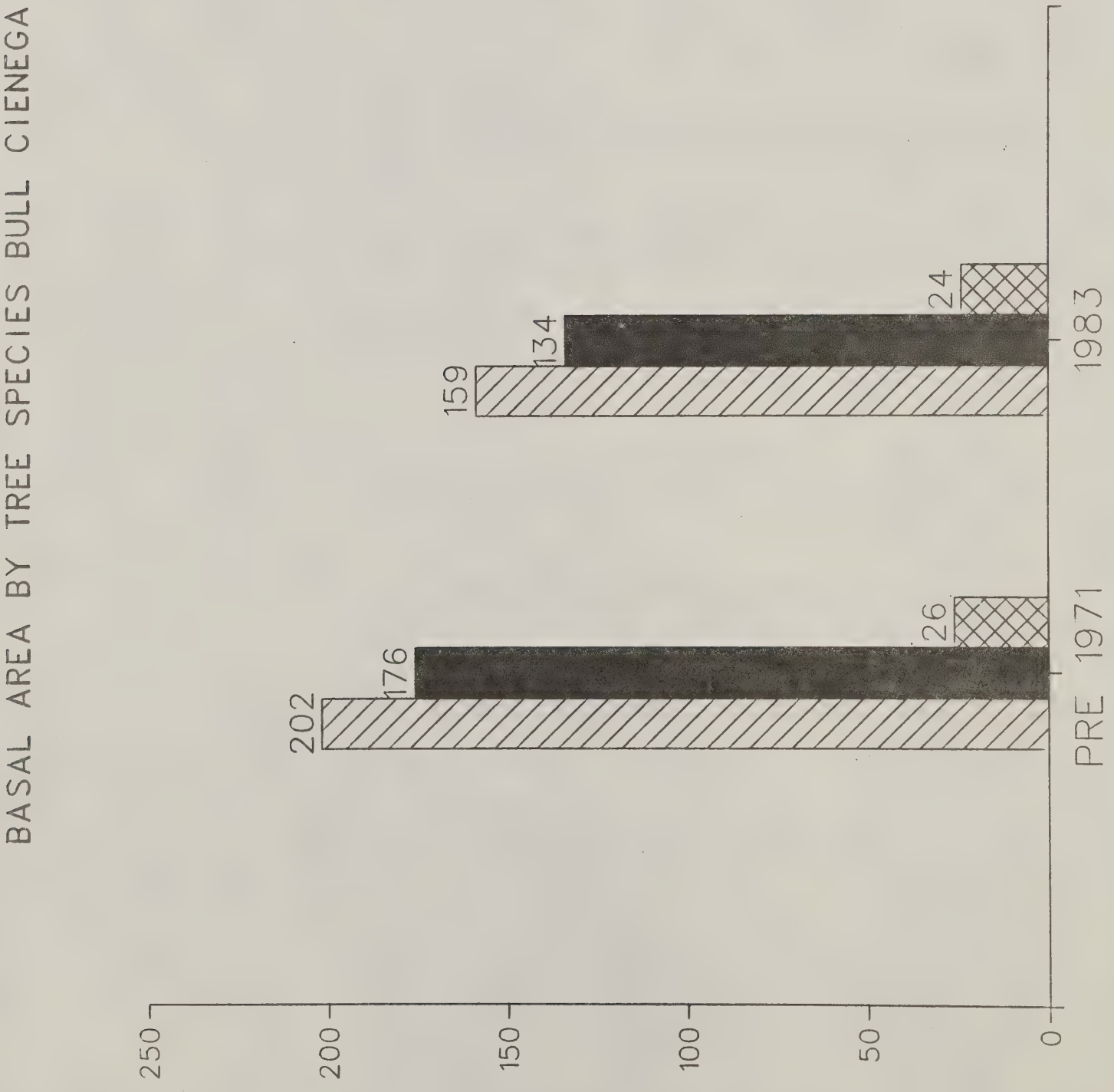

FIGURE 3.--Histogram of basal area by all tree species, live spruce, and non-spruce species for the Diamond Butte compartment

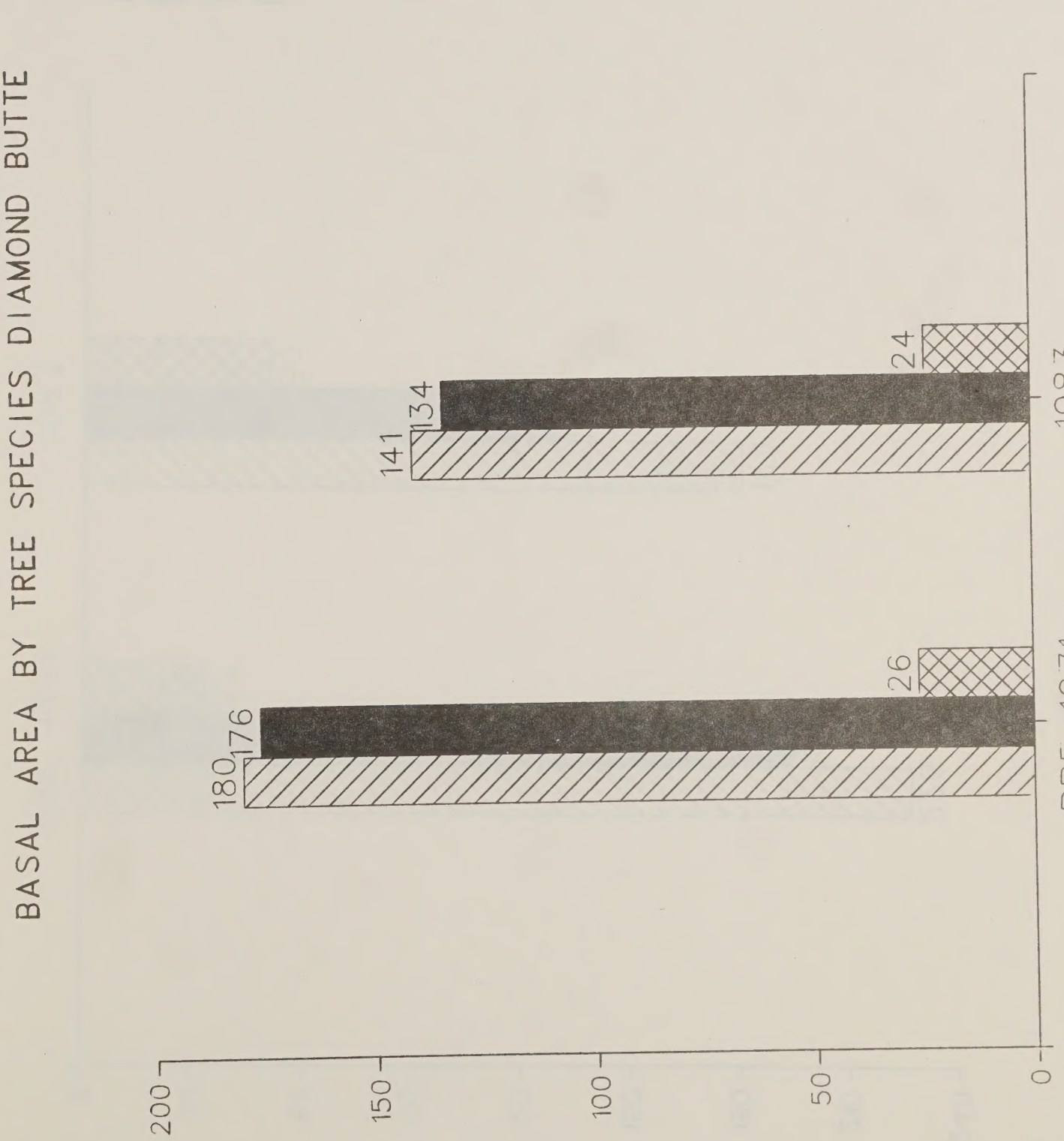

FIGURE 4.--Histogram of basal area by all tree species, live spruce, and non-spruce species for the Mt. Ord compartment